71-

An Announcement of Recent Acquisitions. . .

HSL No. 71-12 March 26, 1971

HS-008 736-754, HS-800 317, HS-800 329-358, HS-800 385-390, HS-800 397-399, HS-820 103

HSL No. 71-12
March 26, 1971

SPECIAL NOTICE
Page ii

THIS ISSUE CONTAINS:

HS-008 736-754
HS-800 317
HS-800 329-358
HS-800 385-390
HS-800 397-399
HS-820 103

U.S. Department of Transportation / National Highway Traffic Safety Administration

Published Weekly by the National Highway Traffic Safety Administration
Washington, D.C. 20591

INTRODUCTION

Publications announced in *Highway Safety Literature* include the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 71 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in location citations by the HS-number, the cover bears the inclusive entry numbers for each issue.

Entries in *HSL* are arranged according to the revised NHTSA Subject Category List shown in the Table of Contents. The List is a two-level arrangement consisting of five major subject fields subdivided into 58 subject groups. Documents related directly to the National Highway Traffic Safety Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration; or for purchase from NTIS (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array	
NHTSA Accession no......	HS-800 218 Fld. 5/21; 5/9
Title of document.........	AN INVESTIGATION OF USED CAR SAFETY STANDARDS--SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L
Personal author(s).........	by E. N. Wells; J. P. Fitzmaurice; C. E. Guilliams; S. R. Kalin; P. D. Williams
Corporate author..........	Operations Research, Inc., Silver Spring, Md., O15000 ← For computer use only
Collation	
Publication date............	12 Sep 1969 150p Contract FH-11-6921 Report no. ORI-TR-553-Vol-6; PB-190 523
Abstract........................	Appendices G-L to this study of used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.
	Search terms: Wear /Trucks; Failures /Trucks; Used cars; Inspection standards /Trucks; Inspection standards /Data
	AVAILABILITY: NTIS

HS-004 497 Fld. 5/19

AUTO THEFT–THE PROBLEM AND THE CHALLENGE

by Thomas A. Williams, Sr.

Journal citation . . . Published in *FBI Law Enforcement Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto theft problem and comments on antitheft devices available now or in the planning stage.

Search terms: Theft, Theft protection, Stolen cars

TABLE OF CONTENTS

NOTE: ( ) Numbers in parentheses following certain subject groups indicate the Highway Safety Program Standards (No. 1, and up) and/or Federal Motor Vehicle Safety Standards (No. 101 and up) which may apply to these groups.

INTRODUCTION AND SAMPLE ENTRIES . . . . Inside Front Cover
AVAILABILITY OF DOCUMENTS ii

NHTSA SUBJECT FIELDS AND GROUPS

1/0 ACCIDENTS . . . . —
- /1 Emergency Services (11, 15-16)
- /2 Injuries
- /3 Investigation and Records (10, 14-15)
- /4 Locations (9, 14)

2/0 HIGHWAY SAFETY 1
- /1 Breakaway Structures
- /2 Communications
- /3 Debris Hazard Control and Cleanup (15-16)
- /4 Design and Construction (12, 14)
- /5 Lighting (14)
- /6 Maintenance (12)
- /7 Meteorological Conditions
- /8 Police Traffic Services (15)
- /9 Traffic Control (13-14)
- /10 Traffic Courts (7)
- /11 Traffic Records (10)

3/0 HUMAN FACTORS 1
- /1 Alcohol (8, 14)
- /2 Anthropomorphic Data
- /3 Cyclists
- /4 Driver Behavior
- /5 Driver Education (4, 14)
- /6 Driver Licensing (5, 10, 14)
- /7 Drugs Other Than Alcohol
- /8 Environmental Effects
- /9 Impaired Drivers
- /10 Passengers
- /11 Pedestrians (14-15)
- /12 Vision

4/0 OTHER SAFETY-RELATED AREAS . . . . —
- /1 Codes and Laws (6)
- /2 Community Support (17)
- /3 Cost Effectiveness
- /4 Governmental Aspects
- /5 Information Technology
- /6 Insurance
- /7 Mathematical Sciences
- /8 Transportation Systems

5/0 VEHICLE SAFETY 2

* All Federal Motor Vehicle Safety Standards apply to passenger vehicles. An asterisk before a subject group indicates additional types of vehicles to which the indicated standards may apply.

- /1 Brake Systems (102, 105-6, 116)
- */2 Buses, School Buses, and Multipurpose Passenger Vehicles (102-4, 106-8, 111-3, 116, 205-6, 209, 211)
- */3 Cycles (3; 108, 112, 116, 205)
- /4 Design (14; 101-2, 105, 107, 201)
- /5 Door Systems (201, 206)
- /6 Fuel Systems (101, 301)
- /7 Glazing Materials (205)
- /8 Hood Latch Systems (113)
- /9 Inspection (1)
- /10 Lighting Systems (101, 105, 108, 112)
- /11 Maintenance and Repairs
- /12 Manufacturers, Distributors, and Dealers
- /13 Mirrors and Mountings (107, 111)
- /14 Occupant Protection (15; 201-4, 207-10)
- /15 Propulsion Systems
- /16 Registration (2, 10)
- /17 Safety Defect Control
- /18 Steering Control System (101, 107, 203-4)
- /19 Theft Protection (114-5)
- */20 Trucks and Trailers (102-4, 107-8, 112-3, 116, 205-6, 209)
- /21 Used Vehicles
- /22 Wheel Systems (109-10, 211)
- /23 Windshield-Related Systems (101, 103-4, 107, 205, 212)

NHTSA DOCUMENTS 5
EXECUTIVE SUMMARIES 15

NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brands names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval by the National Highway Traffic Safety Administration, Department of Transportation of any particular product, course, or equipment.

Harry A. Feinberg
Managing Editor

AVAILABILITY OF DOCUMENTS
AND
INSTRUCTIONS FOR ORDERING

Department of Transportation personnel may borrow copies of publications directly from the NHTSA. Outside the Washington, D.C. area, phone (202) 426-2768. In Washington, D.C. area, use government ID, phone 118-62768. Non-DOT personnel should contact their company or agency libraries for assistance.

Journals cited may be obtained through most research libraries.

Contractors' reports and other documents can usually be obtained as indicated under AVAILABILITY However, there is no certainty that retention copies will be available for more than a limited period after a document is issued.

The more common distribution sources are identified by symbols which are explained below:

NTIS: National Technical Information Service (formerly Clearinghouse for Federal Scientific and Technical Information–CFSTI), Springfield, Va. 22151. *Order by accession number: HS, AD, or PB.* Prepayment is required by NTIS (CFSTI) coupon (GPO coupons are not acceptable), check, or money order (made payable to the NTIS). PC (Paper copy; full size original or reduced facsimile) $3.00 up; *MF* (microfiche approximately 4x6" negative sheet film; reader required) $0.95.

GPO: Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS [CFSTI] coupons are not acceptable), check or money order (made payable to the Superintendent of Documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D C. 20418.

NHTSA: National Highway Traffic Safety Administration General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874).

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report number. Prices given are list; discounts are available to members and sometimes to libraries and U.S. Government Agencies. Prepayment is required; orders without payment are subject to a $1 handling charge.

IMPORTANT

WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS (CFSTI), add DOT/ to the prefix HS-; example HS-800 000 should be ordered as DOT/HS-800 000.

SPECIAL NOTICE

Beginning with the next issue, HSL 71-13, dated April 9, 1971, HIGHWAY SAFETY LITERATURE, will be published every other week (Bi-weekly).

When a National Holiday conflicts with the day of issuance, which is usually Friday, the publishing date will be the proceding day.

2/0 HIGHWAY SAFETY

HS-008 736 Fld. 2/0; 3/0; 5/0; 1/0; 4/5

STATUS REPORT 1970

Michigan Univ., Ann Arbor. Highway Safety Research Inst., M40800

1970 147p 310 refs

The research programs and facilities of the Highway Safety Research Institute are described. Lists of its projects and publications are included.

Search terms: Highway safety organizations; Research facilities / Highway safety; Safety research; Michigan Univ. Highway Safety Research Inst.; Vehicle safety; Information systems; Highway safety / Bibliographies; Accident research; Human factors / Highway safety; Test facilities

2/9 Traffic Control

HS-008 737 Fld. 2/9

GAP ACCEPTANCE AND TRAFFIC INTERACTION IN THE FREEWAY MERGING PROCESS--PHASE 2. FINAL REPORT

by Donald R. Drew; Johann H. Buhr

Texas A and M Univ., College Station. Texas Transportation Inst., T18000

1970 305p 65 refs
Contract CPR-11-5824
Report no. PB-193-901

A rational approach to the design and operation of a freeway control system is presented by defining the functional and operational requirements of the system and the design and installation of a prototype. The operation, detection, and display requirements for a gap acceptance merging control system for individual ramps are presented. Development of a merging control system not necessarily requiring ramp vehicles to stop prior to entering the freeway was investigated. The capacity of a controlled entrance ramp is developed and the control policy consistent with the demand capacity philosophy established. Traffic characteristics associated with control systems are presented. Cost effectiveness and design requirements for freeway control systems are discussed.

Search terms: Ramp control / Traffic capacity; Gap acceptance; Freeways / Merging; Merging capacity / Ramps; Traffic control / Freeways; Benefit cost analysis / Traffic control; Traffic capacity / Traffic control; Traffic characteristics / Freeways; Electronic traffic control / Freeways; Stochastic traffic flow models

AVAILABILITY: NTIS

3/0 HUMAN FACTORS

3/4 Driver Behavior

HS-008 738 Fld. 3/4; 2/4

PSYCHOPHYSIOLOGICAL MEASUREMENTS AS RELATED TO THE OPERATION OF A MOTOR VEHICLE

by Newton C. Ellis; Donna McGlamery

Texas A and M Univ., College Station. Texas Transportation Inst., T18000

July 1970 27p 28 refs
Contract FH-11-7031
Report no. RR-606-3

The feasibility of using physiological parameters as a source of design criteria for the highway visual communication environment was studied. A model for relating physiological performance, driver behavior, and highway design features was introduced and evaluated, and it was concluded that this model could be used in evaluations of the general roadway environment but not specific design features. The model, called a level of arousal model, is a logical framework for relating physiological parameters to vehicle operations. Among the most useful parameters are heart potentials, relative blood pressure, body temperature, respiration rate, brain potentials, and galvanic skin response.

Search terms: Driver behavior; Highway design; Driver vehicle interface; Arousal; Heart rate; Blood pressure; Temperature; Respiration; Brain; Galvanic skin response; Driver performance / Physiology; Driver road interface / Perception

AVAILABILITY: NTIS

HS-008 739 Fld. 3/4

EFFECTS OF FATIGUE ON SKILLS RELATED TO DRIVING. FINAL REPORT

by Harry W. Case; Slade Hulbert; Robert L. Mellinger

California Univ., Los Angeles. Inst. of Transportation and Traffic Engineering, C21000

Jan 1970 56p 47 refs
Report no. UCLA-ENG-7060; PB-194 160

This study undertakes to test the possibility that a decrement in traffic situation judgment exists for certain motorists after a full day of work, before the evening meal is taken. It attempts to measure traffic judgment and to deal with what can be considered a normal amount of fatigue or drowsiness. Questionnaires and driving simulator tests were used to evaluate the performance of three groups of drivers whose habits were categorized as good, medium, and poor. Nearly half the drivers questioned admitted to having trouble staying awake while driving. It was concluded that fatigue contributes significantly to accidents, especially in the case of drivers with poor driving habits.

Search terms: Driver fatigue / Accident causes; Driving simulators / Driver tests; Driver performance / Driver fatigue; Sleep / Accident causes; Food / Driver fatigue; Driver skills / Driver fatigue; Sleep / Physiology; Driver records / Driver fatigue

AVAILABILITY: NTIS

3/12 Vision

HS-008 740 Fld. 3/12

VISUAL REQUIREMENTS IN NIGHT DRIVING

by Thomas H. Rockwell; Ronald L. Ernst; Michael J. Rulon

Ohio State Univ., Columbus, O05400

1970 47p 20 refs
Report no. NCHRP-99

HS-008 740 (Cont'd)

Methods and results of research on the informational needs of night-time drivers are discussed. Studies were conducted on driving performance under nighttime conditions of visual degradation; the effects of selective amounts of visual information on lateral and longitudinal control responses of the night driver; the relationship between velocity and the night driver's sighting distance; visual information acquisition by the night driver; and the development of a selective visual field attenuator for use in an instrumented research vehicle.

Search terms: Night vision; Night visibility; Sight distances /Speed patterns; Vehicle control /Night driving; Visual fields /Measuring instruments; Visual perception / Night driving; Visual degradation / Night driving; Instrumented vehicles /Vision tests; Luminance; Eye movements /Night driving; Glare; Environmental factors /Night driving; Highway lighting; Tracking /Night driving; Sight distances / Night driving

AVAILABILITY: HRB $2.60

5/0 VEHICLE SAFETY

5/4 Design

HS-008 741 Fld. 5/4

COMPARATIVE HEAD-ON IMPACT TESTS OF CARS WITH EITHER FRONT TRANSVERSE OR REAR MOUNTED ENGINES

by J. G. Wall; R. N. Kemp; J. Harris

England. Road Research Lab., Crowthorne, Berks., E14400

1970 122p
Report no. RRL-LR-155

The impact performances of three car models with front engines and front wheel drives and three car models with rear engines and rear wheel drives have been determined by driving them head on into a massive concrete barrier. Dummy occupants provided with different types of safety belt were carried in all but one test. The shape of the deceleration-time curve in all but one model of rear engine car approximated to a half-sine wave which is probably the best that can be achieved in practice. The transverse engines of the front wheel drive cars did not penetrate the passenger compartment, and there was little steering column penetration, but there was some distortion of the floor in the front compartment. The front ends of the rear engine models tended not to be stiff enough to give optimum energy absorption, and in two models there was excessive intrusion of the steering column.

Search terms: Front engine automobiles /Impact tests; Front wheel drives /Crashworthiness; Rear wheel drives /Crashworthiness; Rear engine automobiles /Impact tests; Deceleration /Rear engine automobiles; Steering column rearward displacement; Energy absorption /Rear engine automobiles; Steering columns /Rear engine automobiles; Barrier collision tests /Front engine automobiles; Barrier collision tests / Rear engine automobiles; Safety belts /Barrier collision tests; Deformation /Floors; Front engine automobiles /Crashworthiness; Rear engine automobiles /Crashworthiness

AVAILABILITY: NTIS

HS-008 742 Fld. 5/4

RESIDUAL STRESSES IN STEEL PARTS AND SINGLE CRYSTAL SILICON

by D. A. Pearson

FMC Corp., Marcus Hook, Pa., F17400

1968 6p
Report no. SAE-710282

Presented at X-Ray Fatigue Div., SAE Fatigue Design and Evaluation Committee, Ann Arbor, Mich., 24-25 Sept 1968.

Examples are given of the heat treatment residual stress and retained austenite distributions in a carburized part, and the residual stress after grinding in another hardened part. Stress fields around dislocations in silicon wafers due to processing are shown by X-ray topographs, illustrating that residual stresses are also of concern in other materials.

Search terms: Heat treatment / Steels; Residual stress measurement /Carbon steels; X ray analysis /Steels; Austenite /Carburizing; Silicon /Residual stress measurement; Hardening /Residual stress measurement

AVAILABILITY: SAE

HS-008 743 Fld. 5/4

RESIDUAL STRESS MEASUREMENTS IN CASE-HARDENED STEELS

by Moritaro Motoyama; Hiroshi Horisawa

Nissan Motor Co. Ltd., Yokohama (Japan), N60600

1968 9p
Report no. SAE-710281

Presented at X-Ray Fatigue Div., SAE Fatigue Design and Evaluation Committee, Ann Arbor, Mich., 24-25 Sept 1968.

An investigation was made of the effect of material, quench severity and case depth on residual stress produced by carburizing. The distribution of stress was affected by carbon gradient and its effect on the M_s temperature in relation to the temperature gradient as influenced by quench severity. The maximum compressive stress was produced outside the case-core boundary near the location of initial transformation. With a more severe quench, it was brought out near the surface, resulting in a higher stress at the surface.

Search terms: Case hardening / Steels; Quenching /Steels; X-ray diffraction /Case hardening; Carburizing /Steels; Carbon steels / Residual stress measurement

AVAILABILITY: SAE

HS-008 744 Fld. 5/4

RESIDUAL STRESSES IN QUENCHED AND TEMPERED PLAIN CARBON STEELS

by D. V. Nelson; R. E. Ricklefs; W. P. Evans

Caterpillar Tractor Co., Peoria, Ill., C33000

1969 10p 5 refs
Report no. SAE-710283

> Presented at X-Ray Fatigue Div., SAE Fatigue and Evaluation Committee, Ann Arbor, Mich., 23-24 Sept 1969.

An investigation was made of factors contributing to maximum compressive residual stress. Stresses from furnace hardening heat treatment were shown to be highest at high hardness, medium carbon content, large section size, and minimum hardenability over the range investigated. Shot peening was found to decrease high heat treatment stresses. An example showed very high fatigue strength in plain carbon steel at high hardness which was related to the very high compressive residual stress induced by severe water quenching during heat treatment.

> Search terms: Hardening /Steels; Heat treatment /Shot peening; Carbon steels /Residual stress measurement; Fatigue (Materials) / Quenching

AVAILABILITY: SAE

HS-008 745 Fld. 5/4

ELECTRICAL POWER SOURCE FOR AUTOMOTIVE QUICK HEAT SYSTEMS

by Jerome P. Frysztak

Motorola, Inc., Franklin Park, Ill., M65100

1971 3p
Report no. SAE-710034

> Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

The adaptation of an automotive alternator designed for charging system applications as a power source for an electric "quick heat" system is de-

reserve electric power can be made easily and at low cost by modification of existing alternator design.

> Search terms: Engine heaters / Alternators; Engine heaters /Electric power generation; Quick heat systems

AVAILABILITY: SAE

HS-008 746 Fld. 5/4

ELECTRICAL QUICK HEAT: CONCEPT AND APPLICATION

by James R. Cherry

Motorola, Inc., Franklin Park, Ill., M65100

1971 4p
Report no. SAE-710033

> Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

An electrical quick heat system, composed of a three-phase alternator, a resistive heating assembly, and simple controls can be easily integrated with a standard hot water heating system or utilized with its own blower and plenum chamber. Such a system, with a 5 in. diameter alternator, can supply up to 2.5kW of power which can be used to give greater than 100 F air temperature boost in less than 30 sec. The simplicity of the system should bring it within most economic bogeys for automotive quick heat systems.

> Search terms: Engine heaters / Alternators; Engine heaters /Electric power generation; Quick heat systems

AVAILABILITY: SAE

5/6 Fuel Systems

HS-008 747 Fld. 5/6

EXPERIMENTAL AND THEORETICAL STUDY OF NITRIC OXIDE FORMATION IN INTERNAL COMBUSTION ENGINES

by George A. Lavoie; John B. Heywood; James C. Keck

The nonequilibrium formation of nitric oxide within the internal combustion engine cylinder is examined. A thermodynamic model which predicts the properties of the burnt and unburnt gases during the combustion process is developed. A set of reactions which govern the formation of nitric oxide is proposed, and rate equations for nitric oxide concentrations as a function of time in the post-flame gases are derived. The time-resolved experimental measurements and the data reduction described confirm that these features should be included in models used to predict the nitric oxide concentrations found in spark ignition engines. It was concluded that formation and decomposition of nitric oxide in the post-flame gases are rate limited at the conditions under which IC engines normally operate; at least in the lean case, the nitric oxide formed in the flame front is negligible; and the state of the burned gas is not uniform.

> Search terms: Nitric oxide / Internal combustion engines; Combustion /Thermodynamic properties; Combustion rate; Lean fuel mixtures /Nitric oxide; Gas formation; Nitric oxide /Spark ignition engines

AVAILABILITY: NTIS

HS-008 748 Fld. 5/6

STUDY OF CATALYTIC CONTROL OF EXHAUST EMISSIONS FOR OTTO CYCLE ENGINES. FINAL REPORT

Stanford Research Inst., Irvine, Calif., S37000

1970 65p 91 refs
Contract CPA-22-69-115
Report no. PB-193 533

This state of the art study concerns the development of catalytic control systems for the emission of oxides of nitrogen from motor vehicles. Since the control of oxides of nitrogen often is coupled with the control of hydrocarbons and carbon monoxide, the application of catalyst systems for the

5/6 Fuel Systems (Cont'd)

HS-008 748 (Cont'd)

Hydrocarbons /Otto cycle engines; Carbon monoxide /Otto cycle engines; Nitrogen oxides /Otto cycle engines; Catalytic converters / Exhaust emission control; Catalytic converters /Otto cycle engines; State of the art studies /Catalytic converters; Costs /Catalytic converters

AVAILABILITY: NTIS

HS-008 749 Fld. 5/6

VEHICLE MAINTENANCE FOR LOW EMISSIONS–A CUSTOMER EDUCATION PROBLEM

by Joseph M. Gall; David A. Olds

Michigan Univ., Ann Arbor, M36600

1971 7p 7 refs
Report no. SAE-710070

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

An automotive tune-up clinic for the purpose of reducing undesirable exhaust emissions was held March 14, 1970, as part of an environmental teach-in. The event was sponsored by the student branch of SAE at the University of Michigan. The results of this event clearly show that improper automotive maintenance can be a major factor in atmospheric pollution. It was found that idle hydrocarbon emissions were reduced by an average of 55% with a tune-up in which the idle mixture ratio and speed were adjusted for minimum carbon monoxide emissions. Our conclusion is that the individual motorist must begin to develop an attitude of responsibility toward the maintenance of his automobile to ensure low emissions.

Search terms: Exhaust emission control /Vehicle maintenance; Exhaust emission control /Tuneup; Air pollution control /Vehicle maintenance; Exhaust emission control / Hydrocarbons; Vehicle maintenance /Consumer education; Idling /Hydrocarbons; Idling / Carbon monoxide; Vehicle maintenance /Driver attitudes

AVAILABILITY: SAE

5/14 Occupant Protection

HS-008 750 Fld. 5/14; 5/4

EFFECT OF LOADING GEOMETRY ON THE STRESS-STRAIN BEHAVIOR OF PLASTIC FOAMS IN CUSHIONING DESIGN STUDY

by Wei-Ming Lee

Dow Chemical Co., Midland, Mich., D23400

1971 7p 13 refs
Report no. SAE-710040

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

The dependence of the compressive stress-stain behavior of plastic foams on the loading geometry and its significance in relation to the cushioning design study for automobile safety is explored. Experimental load-deflection responses obtained under dynamic (impact) and static conditions using loading objects of various different geometry are analyzed. A strong interaction between the loading geometry and the material response existed. The importance of this loading geometry effect in connection with the development of an effective crash padding system for automobile vehicles is discussed in detail in terms of the peak deceleration and the maximum average stress produced upon impact on the plastic foams. The analysis of the test results leads to the conclusion that a realistic evaluation of the cushioning system should incorporate this effect by the selection of an appropriate loading geometry. The dependence of the stress-strain behavior on foam density, foam thickness, and the nature of the base polymer from which the foam is expanded is also briefly discussed in this paper.

Search terms: Padding tests /Plastic foams; Plastic foams /Static loads; Plastic foams /Dynamic loads; Geometric forms /Padding tests; Stress strain characteristics /Padding tests; Occupant protection /Interior design; Geometric forms /Loading tests; Headforms /Loading tests

AVAILABILITY: SAE

5/15 Propulsion Systems

HS-008 751 Fld. 5/15

PROSPECTS FOR ELECTRIC VEHICLES. A STUDY OF LOW-POLLUTION POTENTIAL VEHICLES–ELECTRIC

by J. H. B. George; L. J. Straton; R. G. Acton

Little (Arthur D.), Inc., Cambridge, Mass., L08400

15 May 1968 107p
Contract PH-86-67-108
Report no. PB-193 254; C-69260

A state of the art study has been conducted on the technology on which the future development of electric vehicles depends. The assessment is made on the basis that there will be no major change in the patterns of urban transportation and focuses upon the technical requirements of the vehicle. Technical and cost criteria were established for six classes of electric vehicles, most of which correspond closely in performance to existing conventionally powered types. On the basis of these criteria the prospects for vehicle application of various electric motor and control systems and a wide range of electrical power sources including batteries, fuel cells, and engine-generator-battery hybrids are compared. The most promising systems for further development are identified and recommendations made for the expansion of effort in these areas.

Search terms: Electric vehicles / State of the art studies; Hybrid vehicles; Electric automobiles; Urban transportation /Electric vehicles; Electric automobile design; Batteries; Fuel cells; Electric motors; Generators; Electric vehicles /Air pollution; Transmissions /Electric vehicles; Hybrid batteries; Charging stations /Electric vehicles

AVAILABILITY: NTIS

5/20 Trucks and Trailers

HS-008 752 Fld. 5/20

COMMERCIAL OFF-ROAD VEHICLES

by Z. J. Janosi; R. A. Liston; L. A. Martin; D. A. Sloss

Army Tank-Automotive Command, Detroit, Mich., A67800; Stevens Inst. of Tech., Hoboken, N. J., S43800

1970 31p 44 refs
Report no. SAE-700012

Presented at Automotive Engineering Congress, Detroit, Mich., 12-16 Jan 1970.

Commercial off-road vehicles: farm tractors, construction, logging, over-snow and recreational vehicles are dealt with. Their history, requirements, and future trends are discussed. Farm tractors and construction and logging vehicles evolved to satisfy a need for more power than animals were able to furnish. These vehicles went through many false starts while attempting to break away from processes based on the anatomy and power of animals. Future trends point toward more automation, bigger machines, and driver comfort.
Over-snow vehicles have specific technical requirements. It seems, however, that only recreational over-snow vehicles will proliferate because of economic opportunities. The brief history of recreational vehicles indicates that bigger, faster, more sophisticated and consumer oriented machines can be expected in the coming years.

Search terms: Off the road vehicles /History; Commercial vehicles /Off the road vehicles; Farm tractor design /History; Farm tractor design / Forecasting; Tractor design /History; Snowmobile design /History; Truck design / History; Snowmobile design / Forecasting; Recreational vehicles; Construction vehicle design /History

AVAILABILITY: SAE

HS-008 753 Fld. 5/20; 4/7

THE DYNAMICS OF TRACTOR-SEMITRAILER VEHICLES: THE JACKKNIFING PROBLEM

by E. C. Mikulcik

Calgary Univ., Alta. (Canada), C00500

1971 16p 6 refs
Report no. SAE-710045

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971. Based on a doctoral dissertation submitted to Cornell Univ.

The equations of motion for a tractor-semitrailer vehicle, in which both the tractor and semitrailer can pitch, roll, yaw and translate, are derived and solved numerically in their nonlinear form for steering and braking inputs. The linearized equations are also determined and solved for comparison with the nonlinear model. The results demonstrate the occurrence of jackknifing of the nonlinear model, even without the application of braking forces, for certain steering inputs while the linearized model is stable. Violent jackknifing caused by braking is found to take place in the nonlinear model whenever braking forces at the rear tractor wheels are of sufficient magnitude to limit or reduce the side forces occurring there; locking of the wheels is not required. Jackknifing can not always be prevented by damping (short of locking) at the hitch, but the action can be slowed down considerably.

Search terms: Tractor semitrailers / Jackknifing; Tractor semitrailers / Vehicle dynamics; Equations of motion /Tractor semitrailers; Tractor semitrailers /Suspension systems; Tractor semitrailers /Mathematical models; Tractor semitrailers / Braking; Tractor semitrailers /Tires; Tractor semitrailers /Damping

AVAILABILITY: SAE

HS-008 754 Fld. 5/20; 5/18

THE DYNAMIC PERFORMANCE OF ARTICULATED HIGHWAY VEHICLES—A REVIEW OF THE STATE-OF-THE-ART

by Howard Dugoff; R. W. Murphy

Michigan Univ., Ann Arbor. Highway Safety Research Inst., M40800

1971 11p 73 refs
Report no. SAE-710223

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

This paper reviews the state of theoretical and experimental technology relative to the dynamic performance of articulated highway vehicles. The review contains three major sections, corresponding to the traditional breakdown of vehicle performance: directional performance, braking performance, and combined directional and braking performance. An attempt is made to take a frankly evaluative point of view and to point out knowledge gaps and unanswered questions, in addition to documenting previous accomplishments and progress. The paper concludes with some recommendations for future research consistent with the findings of the review.

Search terms: Articulated vehicle performance /State of the art studies; Braking /Articulated vehicle performance; Steering /Articulated vehicle performance; Turning / Articulated vehicle performance

AVAILABILITY: SAE

NHTSA DOCUMENTS

NHTSA Contractors Reports

HS-800 317 Fld. 3/4

INVESTIGATION OF FACTORS AFFECTING DRIVER ALERTNESS. FINAL REPORT

by E. Donald Sussman; Dominic F. Morris

Cornell Aeronautical Lab., Buffalo, N. Y. C67200

Aug 1970 112p 94 refs
Contract FH-11-7313
Report no. CAL-VJ-2849-B-1

The study consisted of a review of the literature concerned with driver alertness, and an experimental investigation of the effects of three variables: driving time, acoustic noise, and task complexity on driver performance. The findings were that during long-duration, low-event driving, drivers showed a linear increase in road position error; during emergencies such as a blowout, the driver's position error increased after four hours of driving,

NHTSA Contractors Reports (Cont'd)

HS-800 317 (Cont'd)

and this increase is most marked under high noise conditions. In addition, the study revealed no degradation in performance attributable to the use of a "speed controller" (a device which automatically maintains a preset speed). The study also includes suggestions for future research and possible methods of alleviating the effects of reduced alertness.

> Search terms: Driver behavior / Bibliographies; Driver behavior / Reviews; Driver behavior research; Attention; Driving tasks / Driver errors; Driver fatigue / Driver errors; Noise tolerances / Driver errors

AVAILABILITY: NTIS

HS-800 329 Fld. 1/3; 4/5

PROCEEDINGS OF THE COLLISION INVESTIGATION METHODOLOGY SYMPOSIUM, WARRENTON, VIRGINIA, AUGUST 24-28, 1969

Cornell Aeronautical Lab., Inc., Buffalo, N. Y., C67200

1969 803p 170 refs
Contract FH-11-7153

> Sponsored by National Highway Safety Bureau, and Automobile Manufacturers Association, Detroit, Michigan

Papers presented at this symposium on collision investigation discussed the following areas: data needs and history of accident investigation; accident causation; injury causation; tools and technical applications; accident investigation in other countries; vehicle damage and injury indices; data systems; and legal aspects.

> Search terms: Accident investigation / Research methods; Multidisciplinary teams; Information systems / Accident investigation; Accident investigation / Sampling; Severity indexes; Medical case reports; Accident analysis; Injury causes; Audiovisual aids / Accident investigation; Accident simulation; Accident investigation / Legal factors; Accident causes; Photographic equipment / Accident investigation

AVAILABILITY: NTIS; Includes HS-800 330 thru HS-800 358

HS-800 330 Fld. 1/3

MOTOR-VEHICLE INDUSTRY COLLISION DATA NEEDS

by Louis C. Lundstrom

General Motors Research Labs., Warren, Mich., G10800

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p12-28

> Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

General types of data required for detailed accident reporting are outlined. Industry needs accident data to insure the identification of accident involvement rates independent of such factors as the driver, the road, or the traffic. A second type of data is required for package evaluation relating to accident and injury severity. A third type of accident detail is required to establish the vehicle components contributing to accident causation and injury causation. Such studies also may yield information regarding human tolerance.

> Search terms: Accident research / Automotive industry; Research methods; Accident investigation; Accident reports; Data acquisition; Accident severity; Injury severity; Accident causes; Injury causes

AVAILABILITY: *In* HS-800 329

HS-800 331 Fld. 1/3

THE FEDERAL GOVERNMENT'S COLLISION DATA NEEDS

by Wendell G. Eames

National Highway Safety Bureau, Washington, D. C., N18000

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p29-53

> Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Progress being made in determining where traffic crash data is stored, developing investigation techniques, and defining information requirements for safety research is reported. Priority data needs are identified as: exposure measurements; basic data; speed on impact and measures of energy dissipation; alcohol studies to identify the problem drinker; investigation of other drugs in relation to accidents.

> Search terms: Accident research / Federal role; Research methods / Accident investigation; Data Acquisition / Safety research; Accident reports / Information systems; Accident risks; Impact tests / Energy absorption; Alcohol usage / Driver statistics; Drinking drivers / Accident statistics; Drug caused accidents; Drugs / Synergism; Blood analysis; Accident investigation / Legal factors

AVAILABILITY: *In* HS-800 329

HS-800 332 Fld. 1/3

THE COLLISION DATA NEEDS OF STATE AND LOCAL GOVERNMENTS

by Edmund R. Ricker

Pennsylvania. Dept. of Highways, Harrisburg, P04200

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p54-68

7 refs

> Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

State and local government collision data needs as presently identifiable are summarized as follows: acquisition of meaningful data from accident report forms; design of operator and police report forms; use of "credit card" type embossed plastic drivers' licenses for records; establishment of data banks for drivers' records, motor vehicle description, inspection records, and road description which need not be repeated in the accident report; inclusion in report form of such details as accident severity; use of operators' reports including driver education on the importance of reporting; use of other data sources such as ambulance records, coronors' reports, insurance company records; and retention of flexibility in entire data system to serve current problems and analysis techniques.

Search terms: Accident reports / Information systems; Accident report forms; Data acquisition; Local government /Accident reports; State government /Accident reports; Driver records /Information systems; Vehicle registration /Information systems; Vehicle inspection / Information systems; Insurance industry /Accident statistics; Medical records /Information systems

AVAILABILITY: *In* HS-800 329

HS-800 333 Fld. 1/3

A BRIEF HISTORY OF MOTOR VEHICLE ACCIDENT INVESTIGATION

by Robert A. Wolf; John C. Fralish

Cornell Aeronautical Lab., Buffalo, N. Y., C67200

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p69-110

57 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

This state of the art report on accident investigation begins with a discussion of turn of the century methods and includes comments on the multidisciplinary team approach. A chronology of events is included. Contributions of voluntary agencies, industry, and governments are noted.

Search terms: Accident investigation /History; Accident investigation /State of the art studies; Industries /Accident investigation; Government /Accident investigation; Associations /Accident investigation

AVAILABILITY: *In* HS-800 329

HS-800 334 Fld. 1/3

CONCEPTUAL AND METHODOLOGICAL ISSUES IN ACCIDENT RESEARCH

by Herbert H. Jacobs

Hallmark Cards, Inc., Kansas City, Mo., H00400

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p111-137

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Two types of experimental strategies are presented together with applications to accident research. Type 1 experiments aim towards direct control of causal variables with the ambition of establishing demonstrable cause and effect relationships. Type 2 experiments are planned to establish statistical association between effects and possible causal variables, but executed to make cause and effect relationships strongly plausible. The need for an array of major, professionally managed, reliably funded, accident research institutes or laboratories is emphasized.

Search terms: Research methods / Accident investigation; Accident research /Variables; Accident investigation /Management

AVAILABILITY: *In* HS-800 329

HS-800 335 Fld. 1/3

VEHICULAR COLLISION RESEARCH AT THE GEORGIA INSTITUTE OF TECHNOLOGY

by Paul H. Wright

Georgia Inst. of Tech., Atlanta, G16200

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p138-155

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

A medical-engineering research team approach to accident investigation is described.

Search terms: Accident investigation /Multidisciplinary teams; Accident research /Georgia

AVAILABILITY: *In* HS-800 329

HS-800 336 Fld. 1/3

AIRCRAFT ACCIDENT INVESTIGATION METHODOLOGY

by William L. Halnon

National Transportation Safety Board, Washington, D. C., N30000

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p155-82

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 1969.

The history and organization of the National Transportation Safety Board is presented. The place of other agencies in investigations is discussed together with a general presentation of investigative responsibilities.

Search terms: National Highway Transportation Board /Accident investigation; Aircraft accidents / National Highway Transportation Board; Aircraft accidents / Government industry cooperation; National Transportation Safety Board /History

AVAILABILITY: *In* HS-800 329

HS-800 337 Fld. 1/3; 3/4

PSYCHOLOGICAL AUTOPSY

by John R. Finch

Baylor Univ., Houston, Tex. College of Medicine, B04800

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p183-231

8 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Psychological factors in accidents and methodology in a research project to identify these factors is described. Included as appendices are the questionnaires used by the psychiatrists. The five questionnaires used for the structured interviews with both the families and close relatives for the driver fatalities cover the following aspects: social history, driving history, alcohol involvement, psychiatric evaluation, interviewee respondent evaluation.

Search terms: Accident causes / Psychological factors; Accident investigation /Research methods; Sociological factors /Questionnaires; Driver records /Questionnaires;

NHTSA Contractors Reports (Cont'd)

HS-800 337 (Cont'd)

Alcohol usage /Questionnaires; Psychological factors / Questionnaires; Interviews / Questionnaires

AVAILABILITY: *In* HS-800 329

HS-800 338 Fld. 1/3

TECHNIQUES AND PROCEDURES FOR ACCIDENT INVESTIGATION

by Kenneth J. Tharp; John M. Keryeski

Cornell Aeronautical Lab., Buffalo, N.Y., C67200

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p232-75

11 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Methods of accident investigation are described. Written records, photography, interviewing, and recovery and transportation of vehicle are discussed. A special van which housed a three member team, and documentation systems including closed circuit television is described.

Search terms: Accident investigation /Research methods; Accident investigation /Photography; Accident investigation /Television; Accident record forms; Accident investigation /Interviews; Debris removal /Vehicles

AVAILABILITY: *In* HS-800 329

HS-800 339 Fld. 1/3

METHODOLOGY OF INJURY CAUSATION INVESTIGATION

by Donald F. Huelke; Harold W. Sherman

Michigan Univ., Ann Arbor, M36600

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p276-88

8 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Methodology in accident investigation is described. Crashes involving the current model automobiles, light trucks, and utility vehicles of the present and past two model years are studied. The main concern is injury causation. The organization and the kinds of data and methods of their collection are discussed.

Search terms: Accident investigation /Research methods; Accident investigation /Injury causes; Accident investigation /Data acquisition· Accident investigation /Sampling Accident investigation /Data processing; Accident investigation /Data analysis

AVAILABILITY: *In* HS-800 329

HS-800 340 Fld. 1/3

LABORATORY RECONSTRUCTION OF OCCUPANT-VEHICLE IMPACTS

by L. M. Patrick

Wayne State Univ., Detroit, Mich., W09600

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p289-323

25 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Laboratory simulation of collisions is described. The use of sleds and the results of impact tests are presented.

Search terms: Accident simulation; Impact sleds; Impact tests; Laboratory tests /Accident research; Damage severity; Injury severity

AVAILABILITY: *In* HS-800 329

HS-800 341 Fld. 1/3

PATHOLOGIST'S SUB-LETHAL DETERMINATIONS

by Michael A. Luongo

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p324-47

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

A series of case reports with pictures is presented. Type of injury and cause of injury are detailed.

Search terms: Medical case reports /Accident investigations; Head injuries /Windshields; Heart arrest / Fatalities; Heart diseases /Accident causes; Knee injuries /Brake controls; Neck injuries /Whiplash; Burns /Fuel tank rupture; Burns / Fatalities; Head injuries /Fatalities; Head injuries /Exhaust pipes; Seat belts /Fatalities; Seat belts / Abdominal injuries; Larynx injuries /Dashboards; Chest injuries / Steering wheels; Aortic ruptures / Steering wheels; Chest injuries / Fatalities; Pathology /Accident investigation

AVAILABILITY: *In* HS-800 329

HS-800 342 Fld. 1/3

AUTOMOTIVE CRASH INJURY RESEARCH

by John W. Garrett; Richard C. Braisted; Mary Ann Bouchard

Cornell Aeronautical Lab., Inc., Buffalo, N. Y., C67200

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p348-401

11 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

History, organization, data acquisition, processing and analysis of the ACIR are presented. Samples of report forms and injury severity scales are included.

Search terms: Automotive Crash Injury Research (Cornell) /Accident report forms; Accident investigation /Data processing; Injury severity index /Automotive Crash Injury Research (Cornell); Accident investigation /Data acquisition; Accident investigation /Data analysis; Accident investigation /Sampling

AVAILABILITY: *In* HS-800 329

HS-800 343 Fld. 1/3

USE OF PHOTOGRAMMETRY IN COLLISION INVESTIGATION

by Dietrich W. Berling; Karl Zeiss

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p402-35

9 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

The development, equipment and its use, and application to accident site reconstruction of stereophotogrammetry is presented.

Search terms: Accident investigation /Photogrammetry; Accident investigation /Stereophotography; Stereophotography /Plotters; Stereophotography /Japan; Stereophotography /West Germany; Accident reconstruction /Plotters; Accident location /Plotters; Mobile photographic laboratories /Accident investigation

AVAILABILITY: *In* HS-800 329

HS-800 344 Fld. 1/3; 2/9

TRAFFIC SENSING AND SURVEILLANCE SYSTEM EXPERIMENTAL INSTALLATION, WASHINGTON, D.C.

by Lawrence D. Powers; Merton J. Rosenbaum, Jr.

Bureau of Public Roads, Washington, D. C., B33600

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p436-61

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

A traffic sensing and surveillance system using television to record the scene of an accident or conflict is described. Potential data reduction was discussed.

Search terms: Traffic surveillance / Television; Accident investigation / Television; Data reduction /Accident research; Traffic surveillance / Sensors; Accident surveillance / Television

AVAILABILITY: *In* HS-800 329

HS-800 345 Fld. 1/3

VIDEO INVESTIGATION FOR URBAN FREEWAY COLLISION

by Bruce W. Pince

Space/Defense Corp., Birmingham, Mich., S33900

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p462-474

25 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

An accident surveillance system equipped with 14 television cameras, ultrasonic sensors, dimensional markers, speed and lane controls and other devices is described. Methods for using this system are proposed.

Search terms: Accident surveillance /Television; Accident surveillance /Ultrasonic devices; Accident surveillance /Research methods; Accident surveillance /Sensors

AVAILABILITY: *In* HS-800 329

HS-800 346 Fld. 1/3; 2/4

ACCIDENT SIMULATION BY COMPUTER

by Norman J. DeLeys

Cornell Aeronautical Labs., Inc., Buffalo, N. Y., C67200

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p475-97

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

This paper describes a model that has been developed in a program of ongoing research to provide an analytical tool for studying single vehicle accidents, and in particular, for supplementing experiments in the evaluation of the energy conversion characteristics of existing and proposed roadside terrain features and highway safety devices.

Search terms: Simulation models; Computerized simulation /Graphic techniques; Computerized simulation /Validation; Accident reconstruction /Computerized simulation; Single vehicle accidents /Accident research; Highway accident potential /Computerized simulation

AVAILABILITY: *In* HS-800 329

HS-800 347 Fld. 1/3

METHODOLOGY OF COLLISION INVESTIGATIONS AT BIRMINGHAM UNIVERSITY, ENGLAND

by G. M. Mackay

Birmingham Univ., Warwick (England)

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p498-532

6 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Procedures used by the Road Accident Research Unit at Birmingham University for at the scene investigations of traffic collisions are outlined. Problems of sampling and calling procedures are discussed. The at the scene forms are given. The procedures used for collecting data at the site and during follow up are presented.

Search terms: Accident investigation /Research methods; Accident research /Sampling; Communication systems /Accident reports; Accident report forms; Data acquisition / Accident investigation; Accident investigation /England

AVAILABILITY: *In* HS-800 329

HS-800 348 Fld. 1/3

COLLISION INVESTIGATION IN AUSTRALIA

by A. J. McLean

Harvard School of Public Health, Boston, Mass., H04800

Published in *Proceedings of the Collision Investigation Methodology Symposium,* 1969 p533-61

8 refs

Presented at the Collision Methodology Investigation Symposium, Warrenton, Va., 24-28 Aug 1969.

NHTSA Contractors Reports (Cont'd)

HS-800 348 (Cont'd)

Methods used in an Australian accident research project are described. Organization, data requirements, sampling criteria, and data collection are discussed.

Search terms: Accident investigation /Research methods; Accident investigation training; Data acquisition /Accident investigation; Accident research /Sampling; Accident investigation /Australia

AVAILABILITY: *In* HS-800 329

HS-800 349 Fld. 1/3

COLLISION INVESTIGATIONS IN THE REPUBLIC OF SOUTH AFRICA

by J. R. Odendaal

South Africa. National Inst. for Road Research, Pretoria, S26400

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p562-631

5 refs

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Methods used in a South African accident research project are described. Organization, data requirements, sampling criteria, and data collection are discussed. Although the author recognizes limitations in the case study method of accident investigation, he considers it to be the most effective means of obtaining more insight into the causative factors involved in particular accidents and into the local road accident problem as a whole. A sample of the accident report form is included.

Search terms: Accident investigation /Research methods; Accident analysis /Accident investigation; Data processing /Accident investigation; Accident research /Sampling; Data acquisition /Accident investigation; Accident report forms; Accident investigation /South Africa

AVAILABILITY: *In* HS-800 329

HS-800 350 Fld. 1/3

DEVELOPMENT OF A MEDICALLY ACCEPTABLE INJURY SCALE

by Harold A. Fenner, Jr.

American Medical Assoc., Chicago, Ill., A34200

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p632-53

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Presently used injury scales of which three are included are reviewed. The American Medical Association's Abbreviated injury scale is discussed more fully. The author suggests that vehicle damage severity indexes should be correlated with the injury severity indexes. Questions from the floor related to scaling of fatal injuries and to emergency medical care. None of the present scales includes burns.

Search terms: Injury severity index; Damage severity index; Medical treatment; Burns /Injury severity index; Fatalities /Injury severity index

AVAILABILITY: *In* HS-800 329

HS-800 351 Fld. 1/3

THE VEHICLE DEFORMATION INDEX: A REPORT FROM THE INTERNATIONAL AD HOC COMMITTEE FOR COLLISION DEFORMATION AND TRAUMA INDICES

by Arnold W. Siegel

California Univ., Los Angeles, C18600

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p654-74

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

An index for describing vehicle deformation is discussed. Although primarily designed for automobile collisions, the index is applicable with a location modifier to truck or bus collisions. Further, the index may be applied to any size vehicle–domestic or import–for it relates to direction of impact, to location of deformation and to relative damage as a function of pre-impact size. Use of this index is illustrated by drawings and photographs.

Search terms: Damage index; Deformation analysis; Accident investigation /Damage index; Deformation analysis /Impact angle

AVAILABILITY: *In* HS-800 329

HS-800 352 Fld. 1/3

THE TRAFFIC ACCIDENT DATA PROJECT SCALE

by B. J. Campbell; Francis Gendre

North Carolina Univ., N65700

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p675-81

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

A damage rating scale for which a manual has been developed is described. Validation of the scale is under way. Properties of the scale are presented.

Search terms: Damage severity index /Validation; Damage severity index /Properties

AVAILABILITY: *In* HS-800 329

HS-800 353 Fld. 1/3; 4/5

GM-ADAP–AN EFFICIENT SYSTEM FOR THE COLLECTION, STORAGE, AND RETRIEVAL OF ACCIDENT INFORMATION

by Robert A. Rogers; Wilton D. Nelson; Arline R. Rinninger

General Motors Proving Ground, Milford, Mich., G09600

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p682-703

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

This description of an information system for accident investigation includes a discussion of the report forms, processing the forms, and accident data analysis programs.

Search terms: Accident analysis; Information systems /Accident investigation; Accident report forms; Data processing /Accident investigation; Accident investigation /Data analysis; Data acquisition /Accident investigation

AVAILABILITY: *In* HS-800 329

HS-800 354 Fld. 1/3

MODERN ACCIDENT DATA ANALYSIS TECHNIQUES

by James O'Day

Michigan Univ., Ann Arbor, M36600

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p704-21

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

This paper discusses the problem of sample size for accident data and the capabilities of modern data processing tools to perform analysis rapidly on such data. Tables, histograms, and graphs showing relationships between car models, accident types, and time of accidents are included.

Search terms: Accident investigation /Sampling; Accident analysis /Information systems; Histograms /Accident analysis; Graphs / Accident analysis; Automobile models /Accident types; Accident investigation /Data analysis

AVAILABILITY: *In* HS-800 329

HS-800 355 Fld. 1/3

DATA PROCESSING AND ANALYSIS TECHNIQUES

by Donald F. Mela

National Highway Safety Bureau, Washington, D. C., N18000

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p722-30

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

Collection of accident data and its use for statistical analysis together with computer applications are discussed in general terms. The NHSB National Accident Summary is described. The importance of indices in measuring data is emphasized.

Search terms: Accident investigation /Information systems; Accident analysis; Accident statistics / Data acquisition; Federal state relationships /Accident statistics; Injury severity index; Damage severity index; Accident severity index; Accident investigation /Data analysis

AVAILABILITY: *In* HS-800 329

HS-800 356 Fld. 1/3

A NATIONAL COLLISION DATA COLLECTION SYSTEM

by Eugene E. Flamboe

National Highway Safety Bureau, N18000

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p731-8

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

The organization of the National Highway and Injury Analysis Center is described. The currently used system is organized as tri-level: basic level–police investigation and reporting; intermediate level–a team approach at the state level having as a nucleus a specially trained police officer and a highway engineer; and third level–multidisciplinary teams. Plans call for adding more teams to the present fifteen. It was pointed out that the diversity of report forms, data acquisition, and data processing mitigate against valid statistical analysis.

Search terms: Accident investigation /Federal state relationships; Multidisciplinary teams; Police reports; Accident report forms; Accident analysis

AVAILABILITY: *In* HS-800 329

HS-800 357 Fld. 1/3

THE ROLE OF THE POLICE IN COLLISION INVESTIGATION

by E. M. Pitcher

Utah. Dept. of Public Safety, Salt Lake City. Highway Patrol, U17600

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p740-52

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

The role of accident investigation and reporting is discussed. Police as a part of the investigating team is emphasized. Participation of state police with a Cornell project is cited as example of a beneficial association. The police report is projected as a continuing necessity as is the need for up to date processing systems.

Search terms: Police reports; Police cooperation with other agencies / Accident investigation; Accident analysis /Information systems; Police reports /Data processing

AVAILABILITY: *In* HS-800 329

HS-800 358 Fld. 1/3

LEGAL ASPECTS OF DATA COLLECTION IN AUTOMOBILE COLLISION INVESTIGATIONS

by James Patrick Smith, Jr.

Baylor Univ., Houston, Tex. College of Medicine, B04800

Published in *Proceedings of the Collision Investigation Methodology Symposium*, 1969 p753-63

Presented at the Collision Investigation Methodology Symposium, Warrenton, Va., 24-28 Aug 1969.

The legal factors of accident investigation regarding the data and the investigator are discussed in light of the Highway Safety Act of 1966, Section 106/which provides that agents of the federal government and their findings can be subpoenaed. Although no court decision has been sent down, the author believes that accident investigators under contract to the federal government are not agents of the federal government. Advice on course to follow in case of subpoena, how to avoid legal involvement, and personal interviewing problems is given.

Search terms: Multidisciplinary teams /Legal factors; Highway Safety Act of 1966 /Accident inves-

NHTSA Contractors Reports (Cont'd)

HS-800 358 (Cont'd)

tigation; Accident reports /Legal factors; Data acquisition /Legal factors; Interviews /Legal factors

AVAILABILITY: *In* HS-800 329

HS-800 385 Fld. 5/17

VEHICLE-IN-USE SYSTEM SAFETY ANALYSIS. VOL. 1. SUMMARY REPORT. FINAL REPORT.

Booz-Allen Applied Research, Inc., Bethesda, Md., B20400

Sep 1970 57p
Contract FH-11-7316
Report no. 9073-026-001

A detailed analysis was undertaken to identify and rank vehicle failure modes according to their criticality, defined as the product of probability of occurrence of a fault times its potential effect in accident causation. Detailed fault logic diagrams were developed for five systems: brakes, steering, power management, visibility, and human impairment related components. Fault probability data were reviewed from accident records, diagnostic data, and records of leasing fleets, the last serving as the primary source. An effects scale was developed using the "Delphi" technique to solicit expert opinions from safety personnel, and specific faults were placed on this scale. Criticalities were computed for all faults for which probability data were available. Conclusions included a ranked list of fault criticalities by system and a series of recommendations for improving vehicle safety.

Search terms: Accident risk forecasting /Failures; Accident causes / Failures; Accident risk forecasting / Defects; Accident causes /Defects; Brake failures /Accident risk forecasting; Steering system failures / Accident risk forecasting; Acceleration /Accident risk forecasting; Driver physical fitness /Accident risk forecasting; Visibility /Accident risk forecasting; Accident records / Failures; Accident records /Defects; Diagnostic centers /Failures; Diagnostic centers /Defects; Fleets / Failures; Fleets /Defects; Vehicle safety; Fuel system failures /Driver physical fitness; Inspection standards; Used automobiles

AVAILABILITY: NTIS

HS-800 386 Fld. 5/17

VEHICLE-IN-USE SYSTEM SAFETY ANALYSIS. VOL. 2. BACKGROUND AND OVERVIEW. FINAL REPORT.

Booz-Allen Applied Research, Inc., Bethesda, Md., B20400

Sep 1970 152p 14 refs
Contract FH-11-7316

A detailed analysis was undertaken to identify and rank vehicle failure modes. This volume includes the study methodology, a description of the data base which was analyzed, the criticality ranking index for forecasting the probability that a fault will cause an accident, a discussion of the effects of vehicle design characteristics on performance in accident avoidance maneuvers, and an overview of results of the safety analysis.

Search terms: Accident risk forecasting /Failures; Accident causes / Failures; Accident risk forecasting / Defects; Accident causes /Defects; Accident avoidance /Vehicle design; Vehicle safety /Vehicle design; Accident analysis /Accident causes; Indexes /Failures; Data analysis / Failures; Data analysis /Repairing; Research methods /Failures; Safety research /Used automobiles

AVAILABILITY: NTIS

HS-800 387 Fld. 5/1; 5/17

VEHICLE-IN-USE SYSTEM SAFETY ANALYSIS. VOL. 3. SAFETY ANALYSIS OF BRAKING SYSTEM. FINAL REPORT.

Booz-Allen Applied Research, Inc., Bethesda, Md., B20400

Sep 1970 163p 204 refs
Contract FH-11-7316

The safety analysis of vehicle defects that lead to loss or degradation of braking system performance is presented. The fault tree technique is employed to identify and rank defects that impair brake performance and produce vehicle safety hazards. A basic vehicle model of a standard passenger vehicle manufactured in the United States in the past decade is taken as a baseline for analysis. This volume includes the criticality and effect summary, a discussion of brake safety standards, and recommendations for brake safety.

Search terms: Brake failures; Brake systems; Brake standards; Vehicle safety /Brake systems; Vehicle safety /Bibliographies; Recall campaigns /Brakes; Brake failures /Trees (mathematics)

AVAILABILITY: NTIS

HS-800 388 Fld. 3/12; 3/9; 5/17

VEHICLE-IN-USE SYSTEM SAFETY ANALYSIS. VOL. 4. SAFETY ANALYSIS OF VISIBILITY AND HUMAN IMPAIRMENT. FINAL REPORT.

Booz-Allen Applied Research, Inc., Bethesda, Md., B20400

Sep 1970 193p 204 refs
Contract FH-11-7316

Bibliographies in volumes 3 through 6 are identical.

Safety analysis of vehicle defects that lead to driver impairment is presented in this volume. The fault tree technique is employed to identify and rank these defects. Factors that relate to impairment of driver visibility are discussed separately from factors that contribute to other types of physical and psychological impairment. A discussion of safety standards and additional research in this field is included.

Search terms: Trees (mathematics) /Defects; Driver physical fitness /Vehicle design; Driver mental fitness /Vehicle design; Safety standards /Visibility; Safety standards /Human factors; Psychological factors /Vehicle design; Vehicle safety /Human factors; Vehicle safety /Bibliographies; Emissions /Driver physical fitness; Driver vision standards

AVAILABILITY: NTIS

HS-800 389 Fld. 5/18; 5/17

VEHICLE-IN-USE SYSTEM SAFETY ANALYSIS. VOL. 5. SAFETY ANALYSIS OF STEERING SYSTEM. FINAL REPORT.

Booz-Allen Applied Research, Inc., Bethesda Md., B20400

Sep 1970 148p 204 refs
Contract FH-11-7316

Bibliographies in volumes 3 through 6 are identical.

The steering system of a typical American-made vehicle in use has been analyzed to determine steering system components and parameters critical to highway safety and to recommend areas for the development of steering system safety standards or additional research. The fault tree technique was used to identify and rank defects. An effect and criticality summary is included.

Search terms: Steering system failures; Steering system design; Steering systems /Safety standards; Vehicle safety /Steering systems; Steering system failures /Trees (mathematics)

AVAILABILITY: NTIS

HS-800 390 Fld. 5/6; 5/17

VEHICLE-IN-USE SYSTEM SAFETY ANALYSIS. VOL. 6. SAFETY ANALYSIS OF POWER MANAGEMENT SYSTEM. FINAL REPORT.

Booz-Allen Applied Research, Inc., Bethesda, Md., B20400

Sep 1970 301p 204 refs
Contract FH-11-7316

Bibliographies in volumes 3 through 6 are identical.

Safety analysis of the power management system employs fault tree techniques to identify and rank vehicle-in-use defects which present safety hazards, using the vehicle elements typically found on a standard American passenger car. The power management system is considered as the means by which the driver controls the speed of the vehicle other than by braking, and includes automatic speed control, fuel storage and supply, and engine conversion and power transmission. A discussion of vehicle emission control methods is also included. Safety standards and additional re-

Transmissions; Power trains / Defects; Trees (mathematics) /Power trains; Vehicle safety /Power trains; Emission control; Safety standards; Recall campaigns /Power trains

AVAILABILITY: NTIS

·HS-800 397 Fld. 5/21

VEHICLE-IN-USE SAFETY STANDARDS. FINAL SUMMARY REPORT

Thompson (John I.) and Co., Rockville, Md., T21400

13 Nov 1970 112p
Contract FH-11-6928

The analyses and interpretations of diagnostic data collected during 1968-69 on more than 20,000 vehicles-in-use at that time are described. Model years covered were 1964 through 1968. A figure of merit based on system outages per vehicle was employed. Data analysis indicated older car models have more individual system outages, outages requiring replacement are few in car's early history and reach a plateau in about two years, and outages requiring adjustment appear to increase throughout the period covered by the sample. System outages per vehicle data for manufacturers show very little difference between makes or models.

Search terms: Used automobiles / Safety standards; Used automobiles /Defective vehicles; Figure of merit /Defective vehicles; Vehicle age /Defective vehicles; Automobile models /Defective vehicles; Defects /Statistical analysis; Diagnostic centers /Statistical analysis

AVAILABILITY: NTIS

HS-800 398 Fld. 5/22

POLYESTER AND BELTED TIRE ROAD TEST EVALUATION. VOL. 1, SUMMARY REPORT, INCLUDING APPENDIX 1 THROUGH APPENDIX 4

by James E. Dobbins

Nevada Automotive Test Center, Carson City, N37200

Nov 1970 81p
Contract FH-11-7435

control tires to determine their operational capabilities in terms of the safety related parameters of speed, load, inflation, and impact are presented. Tires tested in this study were polyester bias, polyester bias belted, rayon bias, rayon bias belted, radial rayon belted, and nylon bias. Conclusions were: no safety related failure occurred at manufacturers recommended load and inflation levels; nondestructive inspection did not predict any mode of tire failure experienced; no safety related distinction can be drawn between various tire fabric materials used in plies or belts; no safety related distinction can be drawn between the various constructions; no safety related failure developed on the front axle.

Search terms: Tires /Road tests; Tire tests /Safety standards; Rayon tires /Road tests; Polyester tires / Road tests; Bias belted tires /Road tests; Bias tires /Road tests; Radial tires /Road tests; Nylon tires /Road tests; Tire materials /Road tests; Tire inflation pressure /Tire tests; Front tires /Road tests; Rear tires /Road tests; Tire failures /Forecasting; Tire loads /Road tests; Speed /Tire tests; Impact tests /Tires

AVAILABILITY: NTIS

HS-800 399 Fld. 5/22

POLYESTER AND BELTED TIRE ROAD TEST EVALUATIONS. VOL. 2, FINAL REPORT, APPENDIX 5 THROUGH APPENDIX 7

Nevada Automotive Test Center, Carson City, N37200

Nov 1970 202p
Contract FH-11-7435

This volume consists of the photographic supplement on failed tires and their x-rays, and the supplements on test directives and raw data to the summary report.

Search terms: Tires /Road tests; Tire failures /Photographs; Tire fail-

NHTSA Imprints

HS-820 103 Fld. 5/17

MOTOR VEHICLE SAFETY DEFECT RECALL CAMPAIGNS–DETAILED REPORTS FROM JULY 1, 1970 TO SEPTEMBER 30, 1970

National Highway Safety Bureau,
Washington, D.C., N18000
1970 349p
Report no. PB-194 580

This volume compiles letters of notification of vehicle defects covering products of 10 domestic and 10 foreign manufacturers. The letters are presented without commentary.

Search terms: Recall campaigns; Defective vehicles; Foreign vehicles/Recall campaigns; Automobil recall campaigns; Defects

AVAILABILITY: NTIS

SPECIAL ANNOUNCEMENT

COMMUNITY ACTION PROGRAM FOR TRAFFIC SAFETY

By

Mel D. Powell, Michael K. Gemmell, Donald Murray and
Warren P. Howe

National Association of Counties
Research Foundation
Washington, D. C.

Under Contract FH-11-7091 with National Highway Traffic Safety Administration

Documents issued to date

I. Responsibilities of Local Officials
DOT/HS-800 309 Abstract appeared in HSL 70-40, December 4, 1970

II. Legal Authority
DOT/HS-800 318 Abstract appeared in HSL 71-1, January 8, 1971

III. Organization and Administration
DOT/HS-800 365 Abstract appeared in HSL 71-8, February 26, 1971

IV. Areawide Approaches
DOT/HS-800 366 Abstract appeared in HSL 71-8, February 26, 1971

V. Planning
DOT/HS-800 406 Abstract appeared in HSL 71-11, March 19, 1971

VI. Staffing
DOT/HS-800 412 Abstract appeared in HSL 71-11, March 19, 1971

All of the above documents are available from NTIS in papercopy (PC) or microfiche (MF).

executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPO

APPLICATION OF THE ORI COST-EFFECTIVENESS SYSTEM TO THE STATE OF WISCONSIN

The broad purpose for which this contract* was awarded was to establish a program to define, develop, and test a cost-effectiveness system to evaluate crash and injury causation countermeasures for application to the analysis of all activities collectively referred to as the "traffic safety program."

*Contract No. FH-11-6495
Operations Research, Inc.
1400 Spring Street
Silver Spring, Maryland 20910
DOT/HS-800 299
PB-196 491

Award Amount:	$429,455.00
Date Report Due:	6/30/70
Date Report Rec'd:	10/19/70
Date of Release:	10/27/70

ORI Technical Report 601

Foreword

The first part of the study (July 1967 to December 1968) involved the development of the cost-effectiveness evaluation system, which is composed of three interrelated models-cost, effectiveness, and allocation. The models were automated and empirically validated using data from the State of Maryland.

The reports resulting from the first part of the study are as follows:

REPORT TITLE: DEVELOPMENT OF A COST-EFFECTIVENESS SYSTEM FOR EVALUATING ACCIDENT COUNTERMEASURES

SUB-TITLES:
- VOLUME I : TECHNICAL REPORT
  - DOT/HS-800 093 PB-183 440
- VOLUME II : APPENDICES
  - DOT/HS-800 094 PB-183 441
- VOLUME III: USER'S MANUAL
  - DOT/HS-800 095 PB-183 442
- VOLUME IV: PROGRAMMER'S MANUAL
  - DOT/HS-800 096 PB-183 443
- VOLUME V : OPERATOR'S MANUAL
  - DOT/HS-800 097 PB-183 444
- VOLUME VI: SUPPORTING DOCUMENTS
  - DOT/HS-800 098 PB-183 445

The second part of the study, synopsized here, began in June 1968 as a demonstration project to further develop and implement the above models using a single state, Wisconsin, as a test case. In June 1969, four states—Arizona, New Jersey, North Carolina, and Utah—were added to the demonstration effort. The application of the cost-effectiveness system to these states, which constitutes the third part of the study, is reported separately. That report discusses the application of the models in each of the four states individually. In addition, it reports preliminary findings potentially leading to the development of a national policy to allocate highway safety funds in an efficient manner, generalizing from the 10 percent sample (five states) studied in depth during the past 2 years.

The Wisconsin part of the study, briefly reviewed here, discusses, in six chapters, the development of the Wisconsin data base (Phase I), the preparation of the three-model system for that application to that data base

(Phases I and II), and the analysis of the results of that application (Phase II). A sample of 28 of Wisconsin's 72 counties and 18 of the state's large cities was utilized, with data collected for the 1962 to 1967 period. Following the main body of the report are four appendices which discuss special problem areas involved in the application of the cost-effectiveness system and present the equations from which the final results were derived.

MAJOR FINDINGS AND RECOMMENDATIONS

RESULTS

- The study was geared toward providing answers to the questions critical to decision-making associated with the allocation of highway safety funds. Cost-effectiveness analysis was selected as the technique that would best fulfill this objective. The study provides answers to the following questions:
  - To which countermeasures and geographical areas within Wisconsin should highway safety funds be allocated?
  - What is the extent of the expected loss reductions in terms of fatalities and injuries resulting from the above allocations?
    - Following is a summary of the reductions achieved and the three-model system utilized in the analysis.

Overall Loss Reductions

The optimal allocation of $750,000 in marginal highway safety funds to the 28 sample counties in Wisconsin resulted in the following overall reductions.*

Deaths	13
A-(serious visible injury)	127
B-(visible injury-medium)	176
C-(nonvisible injury-minor)	64

*The objective was to maximize reduction in deaths. Reductions listed are for the 28 counties only, not for the entire state.

Reduction by Standard and County Stratum

Marginal funds were distributed among highway safety standard programs according to the associated expected reductions. The bulk of the marginal funds amounting to 62% were allocated to the Pedestrian Safety Program. This standard also accounted for the largest reduction in deaths and injuries. The only standard not receiving any marginal funds was Highway Design, Construction, and Maintenance.

The allocation of funds is actually made to standard/county combinations. Since effectiveness is estimated over a cross-section of counties for each standard, the standard which indicates the highest payoff is the first one selected for allocation. Then funds are allocated to that standard, by county. Counties are selected to receive funds sequentially, according to the payoff that can be expected on the basis of county size and present level of spending. To summarize, the actual allocation of funds is made to standard/county combinations according to their expected payoff. A technical discussion of this procedure is presented.

In the analysis for the allocation and distribution of funds, county stratum was employed. The 28 sample counties were grouped by Standard Metropolitan Statistical Area (SMSA), or simply by population. The distribution of funds by stratum is as important as the distribution by county; for just as the 28 counties are a sample of the 72 counties in Wisconsin, each stratum is representative of a grouping of counties in the state that fall into a specific category. The number of counties within each stratum receiving funds for each standard is tabulated in the report, since decision-makers will find it useful to analyze the allocation from the standpoint of both stratum and standard.

*Standard Metropolitan Statistical Area (SMSA) is a county or group of contiguous counties that contains at least one central city of 50,000 or more inhabitants. In addition, other contiguous counties are included in an SMSA if they are essentially metropolitan in character and are socially and economically integrated with the central city.

In the allocation of marginal funds to the sample 28 counties, only marginal funds, three are concentrated in the "non-SMSA 50-80 thousand" stratum and one is in the "SMSA over 80 thousand" stratum. Although it could be expected that a significant payoff would result from allocating funds to larger counties due to the larger number of crashes occuring in such counties, this expectation is not fully supported by the analysis.

Although the pattern of results is not always clear, a number of trends may be discerned from the data presented in the detailed report. From the standpoint of the administrator responsible for the allocation of highway safety funds to specific standards and areas, for the following points of guidance may be delineated:

- For Driver Education, the most productive allocation of funds is directed towards the smaller non-SMSA counties. It is in these areas that the greatest payoff is indicated.
- For Spot Improvement, the same basic trend towards the non-SMSA counties is evident. The SMSA counties did not receive any funds in the Spot Improvement allocation.
- For Traffic Police, only three counties received funds. However, their concentration in the non-SMSA counties under 50,000 persons is a good indicator of where the greatest payoff can be expected.
- For the Traffic Control and the Pedestrian Safety Standards, the indicated payoff is, as expected, in the counties with large population and hence, heavy traffic movement.
    - The above distribution is based upon an allocation of specified marginal funds. If the amount of marginal funds were increased, noticeable shifts in the distribution pattern are possible, with the additional funds possibly allocated to the standards that previously received only a minor portion. It is conceivable that Highway Design, Construction and Maintenance, not included in the current allocation, could receive substantial funds if an increased budget were utilized. The foregoing discussion demonstrates the need to evaluate the results of the allocation within the context of the specified budget of available marginal funds.

COST AND EFFECTIVENESS MEASUREMENT

- The above results were obtained from an allocation of 1968 safety funds to the most productive standards and counties in Wisconsin. This allocation is based upon the statistically estimated standard effectiveness measures from the effectiveness model and the total system costs (TSC) derived from the cost model. In essence, the allocation model uses the information derived from the cost and effectiveness analysis to determine the optimal level and distribution of spending with respect to highway safety standards.

Cost Measurement

The cost measurement involved delineating the costs associated with standard implementation that are incurred by both the public and private sectors. The costs incurred do not necessarily represent the actual outlay of funds; they may represent delay costs which are then translated to monetary terms.

These *public* and *private* costs comprise the total system costs associated with the highway safety standards. The data available to derive TSC for standard implementation are inadequate in both quantity and quality to support the computation of TSC for all standards. A breakdown of the TSC costs, i.e., the annual costs incurred by both public and private sectors in a single year (1967), for those standards for which some supporting data were available, is presented in the report.

A Cost Identification Table (CIT) was used to identify and display the areas in which costs might be incurred. Cost data were then collected as completely as possible from each area identified.

The least satisfactory data were obtained for the private sector measured values were largely estimated from expert opinion. This sitivity analysis of how the allocation of marginal funds is affected by these safety costs. The analysis indicated that while the exclusion of private costs resulted in some minor changes in the allocation, these changes were not significant in magnitude.

Effectiveness Measurement

The effectiveness of highway and traffic safety standards in reducing crash damage was measured by estimating crash reduction by type attributable to each standard utilizing data from 1962-67 in Wisconsin. By using available regression tools, the effectiveness model produced a set of coefficients, relating government expenditures on the standards (independent variables) to crashes by type (dependent variables). These impact measures were used as part of the cost-effectiveness ratios with the impact measure for each crash type translated in fatalities and injuries.

Regression analysis as a statistical technique does not attempt to measure cause and effect. It is used to determine whether a statistically significant relationship exists between crashes (dependent variable) and expenditures on the standards (independent variables). The analysis is subject to all the vagaries usually associated with any statistical technique, especially imprecision in the functional relationships and the quality of the data collected. Furthermore, the use of this technique does not in any way subordinate the results obtained through other research designs, such as controlled experimentation or "engineering" analyses of specific standard effectiveness, which attempts to analyze the highway crash process by deriving physical relationships that are important for describing the system. A complete application of regression analysis to the highway crash process must in some cases await knowledge gained from the latter evaluation techniques. All of the foregoing evaluation techniques can be usefully employed for analyzing various facets of what is obviously a complex problem area.

- The user of outputs from any of these

Implementation of the standards is measured in terms of Federal, state, and local spending (public costs) on each of the standards. The private costs incurred as a result of standard implementation are utilized only in the estimation of the effectiveness-to-cost ratios which serve as the inputs to the allocation model. Thus, while only public funds are allocated, private costs are considered in the estimation of the effectiveness-to-cost ratios and thus have an influence in the selection of the standards to which funds are allocated.

HIGHWAY SAFETY PROGRAMS CONSIDERED FOR SYSTEM ANALYSIS

- Not all of the safety standards are included in the ORI study. The data collection effort in Wisconsin attempted to obtain complete information for all safety standards and their associated activities; however, not all of the standards were amenable to cost-effectiveness analysis within the three-model system. To be included in the cost-effectiveness analysis, a program had to satisfy the following criteria:
    - The outputs that can be defined and are quantifiable.
    - The program is expected to contribute directly to accident reduction rather than to increase departmental efficiency or the flow of information on related matters.
    - The TSC can be obtained accurately.
    - The expenditures, outputs, of a state or local program varied substantially in a cross-section sample so that the programs analyzed may be properly included as variables.
        - The criteria are intended to reflect the extent to which expenditures on highway safety programs conform to the requirements of the statistical analysis required by the three-model system, especially the effectiveness analysis.

Programs Selected for Limited Analysis

Some programs did not meet all of the foregoing criteria for full system analysis. The programs listed first—Motor Vehicle Inspection and Alcohol Breathanalyzers—were excluded from the cost-effectiveness evaluation, but the costs of their implementation were estimated. The former was omitted from the full analysis because the relevant data were not organized on a county basis; the data obtained on the latter program were not representative of the county experience and proved difficult to obtain accurately. Along with the two programs mentioned here, the others are, Emergency Ambulance Service, Shatter-Resistant Windshield, Collapsible Steering Wheel, and Seat Belts. These remaining standards are concerned with the post-crash (Ameliorative-Restorative or A-R) phase. Currently, no method exists to incorporate these standards formally into the three-model system, since no theory statistically relating A-R standards to crash damage has been formulated and expert opinion on the subject is limited. Consequently, these standards were analyzed on a limited basis using the Chi-Square Contingency Analysis to test the significance of the injury distribution for specific crash types.

Programs Omitted from the Analysis

A number of highway safety programs were omitted from the analysis because they did not meet the criteria. Specific reasons for which a program could have been omitted include:

- The program exists primarily to disseminate information and encourage organization, and exerts no direct measurable effect on crashes or mortality, morbidity, and property damage (MMPD).
- The program itself is not well-defined or is widely dispersed or uncoordinated.
- The program represents a change in existing statewide policy and was implemented too late to be subjected to analysis.
  - The programs currently excluded from the analysis could, of course, be included if expenditure patterns change significantly in the future, if a different cross-section of observations is selected or new insight regarding the program's impact on crashes comes to light.

USEFULLNESS OF ORI STUDY TO WISCONSIN OFFICIALS

- The three-model system for evaluating the effectiveness of highway safety measures, with the accompanying optimal allocation of funds to these measures, is designed to aid officials responsible for making the allocation decisions. Continuing system use for a number of years, with improving data, would greatly enhance its value to the decision-making process. In addition, using the model on a continuous basis over time will provide a better "feel" for standard impact, including the possible impact of any changes in the current standards or any proposed new countermeasures.
- The usefulness of the study to Wisconsin state officials is summarized in the following description of attributes of the three-model system.
  - Provides a framework for systematic cost-effectiveness analysis of existing highway safety programs.
    - Since the system is designed to relate program inputs (costs) to program outputs (reduction in MMPD), state decision-makers can evaluate each of the state highway safety programs within the context of a cost-effectiveness analysis. Thus, the planning and implementation of standards and overall allocations to the programs can be systematically and quantitatively analyzed.
  - Provides decision-makers with a rational tool for allocating funds to highway safety programs and geographic areas.
    - The system optimizes the allocation of funds by county and standard on a cost-effectiveness basis. In essence, the highway safety funds are distributed in such a manner as to maximize the payoff in reductions in MMPD. This selection of the specific areas and standards for implementation is dependent upon the quantitative measures generated by the model, where as priorities were pre-

viously determined primarily on judgment and experience.

- Provides an on-going system which can be adapted to accept either revisions in existing programs or new programs once the changes are implemented and data become available.
  - The applicability of the system is definitely not confined to the programs analyzed in the Wisconsin study. The only restriction to its capability is the requirement for historical time series or cross-section data reflecting the extent of program implementation.
- Identifies areas in which information gathering and reporting at the activity level (in the field) should be examined.
  - The model requires an in-depth data survey of standard implementation for all associated activities in all political jurisdictions. When this detailed data analysis has been completed, the system highlights those components of the highway safety data network which require further quantitative or qualitative improvement.
- Three-model system is fully documented and adaptable to most third generation computers (e.g., IBM 360 series, CDC 3100 series).
  - The importance of a fully documented system directed towards a wide range and level of users, cannot be overemphasized. The lack of sufficiently detailed documentation to facilitate system use is often the major reason for non-implementation. Moreover, the adaptability of the system to computer requirements enhances the responsiveness of the system to Wisconsin officials' needs.

Problem Areas Addressed

- Before implementing the ORI system as the major selection tool in the allocation of highway safety funds to the countermeasures, a number of problems require solution. Obtaining statistically trained personnel to run the system might be a major drawback to state implementation in some cases. Other areas of concern are outlined below:

- The efficiency fo the ORI system is dependent upon the accident and standard expenditure data available for the system.
  - To maximize its usefulness as a continuous analytical tool, the system requires some redesign and expansion of the information reporting system at certain levels of government in Wisconsin. Currently, the reporting systems are not geared to providing cost records specifically associated with highway safety standard implementation. These records are required by the ORI system.
- Incorporating new programs for system evaluation requires extensive field testing.
  - Specifically, the effectiveness model requires both historical records and a sufficient cross-section of geographic areas associated with standard implementation before an effectiveness measure can be estimated. Thus a new program must be in existence for a number of years and/or extend into a number of counties before the system is capable of providing a cost-effectiveness evaluation.
- Statistical analysis is not a precise tool; the highway system cannot be completely specified mathematically and the system is subject to unpredictable, random disruptions.
  - The method of deriving effectiveness measures employed in the model is dependent upon measuring the statistical relationship between the standard expenditures and the number of crashes by type. Although the statistical model does include in its formulation many of the known variables affecting crashes, it is difficult to specify these variables to fully describe their interaction within the crash process.
- Many programs e.g., Motor Vehicle Registration cannot be evaluated within the system with respect to their direct impact on crashes and resulting economic loss.
  - Unfortunately, within the current state-of-the-art, the methodology for

incorporating these standards formally into the system is lacking since no theory *statistically* relating these programs to crashes or injuries exists. However, for programs excluded for other reasons, such as the lack of historical cross-section data within Wisconsin, there is the possibility of future inclusion based upon analysis of a different cross-section (states).

Using the ORI System to Overcome Problem Areas

- This last problem indicated above is very important to the decision-maker planning to use the results of this study, since he must make funding decisions with respect to all the standards, plus planning and administration, whether they are included in or excluded from the model and, whether the ORI study recommends spending on them or not. Some guidelines for the decision-maker are:
  - What should the decision-maker do about standards which were not included in analysis? What marginal funds should be expended on these standards?
    - Some standards were excluded because of lack of data; the allocation decision for these standards must be based upon the experience and knowledge of the decision-maker until data for model analysis are available.
    - Some standards were excluded because their implementation is not directly related to crashes. The allocation decisions here must be based upon the value of each supporting standard in improving effectiveness of programs which are directly related to crashes. A continuing analysis employing the model will provide guidance for future decisions.
  - How should the decision-maker consider standards to which the model did not allocate marginal funds? The options open are:
    - Expenditures on these standards should be undertaken on low priority basis.
    - Increasing the marginal funds available may change the allocation so that these standards will receive funds.
    - Further research may uncover innovations which rise the priority of these standards. Proper use of the model, however, assures that both initial investments and operating costs are fully considered before a decision is made regarding implementation.
- A meaningful allocation cannot be developed without proper interaction between the decision-maker, the analyst, and the model. An extremely important aspect of the model is that the full potential of the analytical techniques can only be realized in the hands of a skilled analyst interacting with an experienced decision-maker. The analyst must be capable of indicating the wide range of options that the system can explore. The decision-maker must define and request the information he requires, based on his knowledge of system operation, capability, and basic assumptions. As a result of this interaction, the "best" solutions obtained from the allocation model will constitute approaches that can be feasibly and practically implemented.
  - The model currently is not prepared to answer all of the questions relevant to decision-making for highway officials. Much remains to be done before it can fill the substantial gap between judgment and experience and a quantitative method of optimized allocation of highway safety funds. Improvement of the available data is an obvious initial step towards narrowing this gap. In addition, development of the techniques necessary to enable the model to analyze all of the standards and projected standards would significantly improve its usefulness. The model, at this time, can be considered as a supplementary source of information to aid in the decision process related to allocating highway safety funds.

OPERATIONAL NOTE

- The Wisconsin cost-effectiveness (C/E) demonstration constitutes the initial stage in validating the three-model system—cost, effectiveness, and allocation—developed by Operations Research, Inc. The primary objective of this ORI effort was to demonstrate the potential operational capability of the system for evaluating "real" data representative of the highway safety program, in particular those activities associated with the highway safety standards. The results derived from the model and detailed in the report should not be considered as a guide for an optimal allocation of state funds to the highway safety standards. The study is basically a research effort with the validation of statistical concepts of primary concern. The results should be considered within the framework of an example of how model implementation would function with a particular state.

- The report is an analytical effort concerned with uncovering problems that might be encountered in any future evaluation utilizing the system for an actual optimal allocation of highway funds. The report is not intended as a handbook or manual to assist administrators responsible for making the allocation decisions for highway funds to the safety countermeasures. In fact, the report is designed and written to meet the requirements of analysts concerned with determining methods for evaluating the cost effectiveness of the highway safety standards.

- It will be possible for state and Federal officials to eventually employ the analytic approach described in the report if they meet the following requirements:

  - Hire a competent analyst (statistician) to become knowledgeable of the system concepts and methodology.

  - Establish close cooperation between analysts and operational decision-makers.

  - Initiate extensive data collection effo
    which satisfies model requirements a
    assures that data of high quality, bo
    valid and reliable, are acquired.

    - Beyond the foregoing requirement
      all of the constraints and limitatio
      noted in the report are also applicab
      for any comtemplated evaluation.

- In conclusion, meaningful allocations cann
  be developed without proper interacti
  between the decision-maker, the analyst, a
  the model. An extremely important aspect
  the model is that the full potential of t
  analytical techniques can only be realized
  the hands of a skilled analyst interacting wi
  an experienced decision-maker. The analy
  must be capable of indicating the wide ran
  of options that the system can explore. T
  decision-maker must define and request t
  information he requires, based on his know
  edge of system operation, capability, a
  basic assumptions.

The Contract Manager has certified that t
contractor's work has been satisfactorily co
pleted and that all contractual obligations on t
study have been met.

The opinions, findings, and conclusions e
pressed in this study are those of the contract
and not necessarily those of National Highw
Traffic Safety Administration.

Availability: NTIS, U. S. Department
Commerce, Springfield, Virginia 22151. Ord
DOT/HS-800 299 or PB 196 491 in paper co
(PC) or microfiche (MF).

U.S. GOVERNMENT PRINTING OFFICE: 1970-397-262

ATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICIAL BUSINESS

Penalty For Private Use, $300

POSTAGE AND FEES PAID

FEDERAL HIGHWAY ADMINISTRATIO

NHTSA REGIONAL OFFICES

Region	Address
I	Regional Administrator, NHTSA, Transportation Systems Center, 55 Broadway, Cambridge, Mass., 02142, Tel: 617-494-2681. (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont)
II	Regional Administrator, NHTSA, 4 Normanskill Blvd., Delmar, N.Y. 12054, Tel:518-427-4095. (New Jersey, New York, and Puerto Rico)
III	Regional Administrator, NHTSA, Room 817 Federal Building, 31 Hopkins Plaza, Baltimore, Maryland 21021, Tel: 301-962-3878. (Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia)
IV	Regional Administrator, NHTSA, Suite 200, 1720 Peachtree Road, N.W., Atlanta, Georgia 30309, Tel: 404-526-3405. (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee)
V	Regional Administrator, NHTSA, 18209 Dixie Highway, Homewood, Illinois 60430, Tel: 312-799-6300. (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin)
VI	Regional Administrator, NHTSA, 819 Taylor Street, Room 8A42, Fort Worth, Texas 76102. Tel: 817-334-2021. (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas)
VII	Regional Administrator, NHTSA, P.O.Box 7186, Country Club Station, Kansas City, Missouri 64113, Tel: 816-361-7887. (Iowa, Kansas, Missouri, and Nebraska)
VIII	Regional Administrator, NHTSA, Room 107, Bldg. 40, Denver Federal Center, Denver, Colorado 80225, Tel: 303-233-6429. (Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming)
IX	Regional Administrator, NHTSA, 450 Golden Gate Avenue, Box 36096, San Francisco, California 94102, Tel: 415-556-5450. (Arizona, California, Hawaii, and Nevada)
X	Regional Administrator, NHTSA, Room 301, Mohawk Bldg., 222 S.W. Morrison Street, Portland, Oregon 97204, Tel: 503-226-3754. (Alaska, Idaho, Oregon, and Washington)